## PAPERS.

## 35. On some new Genera and Species of Anomodont Reptiles from the Karroo Beds of South Africa. By R. Broom, F.R.S., C.M.Z.S.

[Received April 6, 1921: Read May 24, 1921.]

(Text-figures 28–45.)

INDEX.

| | Page |
|---|---|
| *Dicynodon sollasi*, sp. n. | 648 |
| „ *andrewsi*, sp. n. | 650 |
| „ *osborni*, sp. n. | 651 |
| „ *watsoni*, sp. n. | 653 |
| „ *curtus*, sp. n. | 654 |
| „ *woodwardi*, sp. n. | 655 |
| „ *ictinops*, sp. n. | 656 |
| „ *macrorhynchus*, sp. n. | 657 |
| *Bainia tigriceps* (Owen), gen. n. | 659 |
| „ *peavoti*, sp. n. | 659 |
| „ *haughtoni*, sp. n. | 661 |
| *Eosimops newtoni*, gen. et sp. n. | 663 |
| *Palemydops platysoma*, gen. et sp. n. | 665 |
| *Emydopsis trigoniceps* (Broom), gen. n. | 666 |
| „ *longus*, sp. n. | 667 |
| „ *sciuroides*, sp. n. | 668 |
| *Emydops parvus*, sp. n. | 669 |
| *Emyduranus platyops*, gen. et sp. n. | 670 |
| *Endothiodon crassus*, sp. n. | 672 |

The genus *Dicynodon* was established by Owen in 1845 for the remarkable South African fossil reptiles discovered by Bain and referred to by him as Bidentals. As the result of the labours of Owen, supplemented by that of later workers, nearly every detail in the structure of the skeleton of *Dicynodon* is now as fully known as that of the Dog. It was a primitive reptile with a skeleton built essentially on the same plan as that of the mammal, but with certain remarkable specializations of the skull, especially in the complete loss of incisor teeth, the presence of a large permanently growing canine in the male, and in the fact of the front of the upper and lower jaws having formed a horny beak as in the tortoise or bird.

While there remains little to add to our knowledge of the skeleton, there is still much to be done ere we have anything like a satisfactory knowledge of the large number of species which must be referred to the genus.

*Dicynodon* first occurs in South Africa at the base of the *Pareiasaurus* zone, which may be regarded as Middle Permian in age, and it extends through all the zones to the top of the Permian, and forms which are very closely allied, if not indeed referable to *Dicynodon*, are met with to the top of the Trias. A form closely allied to *Dicynodon* occurs in the Dwina of Russia, and *Placerias* of the Trias of North America is, if not *Dicynodon* also, at least very closely allied.

*Oudenodon*, originally described as a distinct genus differing from *Dicynodon* in the absence of the tusk, we now know to be the female. So long as all the known species of *Oudenodon* differed from the known species of *Dicynodon* in other characters besides the absence of the tusk, it was felt wiser to keep *Oudenodon* as a distinct genus. In 1909, in summing up the position at that time, I stated that the evidence seemed "to be getting stronger in favour of *Oudenodon* being but the female *Dicynodon.*" By 1911 the discovery of tusked and tuskless specimens of *Dicynodon bolorhinus* in one locality removed all doubt, and since then we have discovered tusked and tuskless specimens of quite a number of species. We do not yet know whether the females of all species are tuskless, and there is considerable reason to believe they are not. And it is also possible that even the males of some species at present referred to *Dicynodon* may be tuskless. The genus *Lystrosaurus* is certainly tusked in both sexes, and as all known specimens of *Cistecephalus* are without tusks, presumably both sexes are tuskless. All the known specimens—about a dozen—of *Kannemeyeria* are tusked. Also every known specimen of *Dicynodon tigriceps* or allied species is tusked, while the few known specimens referred to *Eocyclops* are tuskless. Species where both sexes are tusked or both tuskless will have to be placed in distinct genera or at least subgenera.

When Owen worked at *Dicynodon* and *Oudenodon* he made nearly every skull the type of a distinct species, and there were doubtless many who considered that he was over liberal in the making of new species. Lydekker in 1890 reduced Owen's 20 species to 11 good and 3 doubtful species, but there is now little doubt, with our much greater knowledge of the genus, that practically all Owen's types are good. In my opinion, out of the 20 specific names only two can be regarded as synonymous—*D. pardiceps* and *D. rectidens,* both of which I refer to *D. leoniceps* Ow.

It is hardly surprising that a genus which survived for probably over 2,000,000 years should have over 50 species already known, and probably very many more to be discovered, when we consider how many species of such reptiles as *Testudo* or *Lygosoma* are at present alive. Until a few years ago nearly every good specimen discovered seemed to belong to a new species. Now the corner seems to be turned, and the majority of *Dicynodon* skulls now picked up can be referred to species already known.

In the present paper I wish to describe a number of new forms I have discovered in the past three years.

### DICYNODON SOLLASI, sp. n. (Text-figs. 28, 29.)

This new species I have much pleasure in naming after Prof. W. J. Sollas, who with his daughter has added so considerably to our fuller knowledge of the structure of the *Dicynodon* skull*. It is founded on a series of over 20 good skulls and many imperfect ones discovered near Biesjespoort on a horizon which I believe to be at the very top of the *Endothiodon* zone, and it appears to extend a short way into the *Cistecephalus* zone. Though many skulls, both males and females, are known, I take as the type one of the best preserved, which I believe to be an adult male. It is about 5 inches in length and a little less than 4 inches in width.

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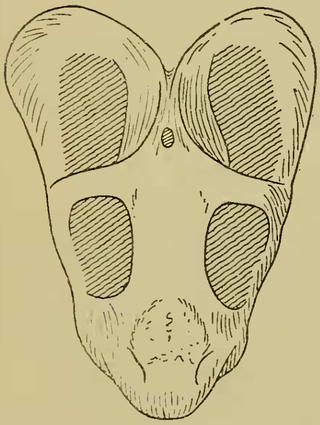
* In connection with the work on *Dicynodon* by Prof. and Miss Sollas, I should like to point out that the skull examined by them in 1913 cannot possibly be *Dicynodon leoniceps* Owen. As the specimen is now, of course, completely gone, and as the postorbitals have manifestly been partly weathered away before the specimen was ground down, it will never be possible to determine the species with absolute certainty. In my opinion the specimen was *Dicynodon feliceps* Owen.

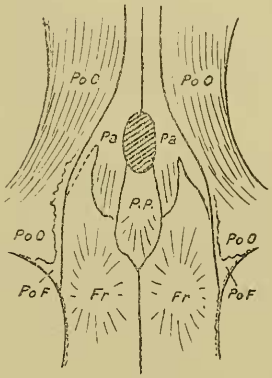
The beak is about the same length as the orbit and moderately sharp in front. The nostrils are fairly large, and behind them the maxillaries meet the nasals, and the septomaxillaries do not appear on the side of the face.

Immediately behind the plane of the nostrils is a thickening of the bones which forms a round button-like low boss in the middle line. Above and behind the canine is a thickened elongated ridge.

Text-figure 28.



Text-figure 29.



Text-fig. 28.—Skull of *Dicynodon sollasi* Broom. Reduced.

Text-fig. 29.—Preparietal region in *Dicynodon sollasi* Broom. Nat. size.

The interorbital region is flat and narrow. The orbits look upwards and outwards.

The parietal region is only very slightly wider than the interorbital, and the large postorbitals largely overlap the parietals and almost meet in the middle line.

The preparietal region is not well displayed in the type skull, but is well seen in a number of others.

The pineal foramen is relatively small, and is situated a few millimetres behind the plane of the back of the postorbital arch. The preparietal is small, and is flanked by fairly large anterior processes of the parietals. The postfrontals are nearly obscured by the parietals and postorbitals, but form a distinct though small part of the orbital margins.

The following are the principal measurements of the type skull:—

| | | |
|---|---|---|
| Greatest antero-posterior length | 128 | mm. |
| Width across squamosals | 88 | ,, |
| Intertemporal width | 22 | ,, |
| Interorbital width | 21 | ,, |
| Width across maxillary bosses | 52 | ,, |
| Width between nostrils | 15 | ,, |
| Width between canine roots | 32 | ,, |

*Dicynodon sollasi* bears considerable resemblance to *D. feliceps*, *D. ictidops*, and *D. testudiceps*. From *D. feliceps* it differs in being a much more delicately built skull and with a very much feebler tusk, the tusk in *D. sollasi* being about half the thickness of that in *D. feliceps*. In *D. testudiceps* the postorbitals meet each other in the middle line over the parietals; in *D. sollasi* the postorbitals do not overlap the parietals so very greatly. *D. ictidops* comes from a horizon which is probably 500 feet lower than that which yields *D. sollasi*; so that there is a strong presumption in favour of the two being distinct species, though they are undoubtedly closely allied. The preparietal in *D. sollasi* is smaller than in *D. ictidops*, and the general contours of the bosses differ considerably in the two species.

### DICYNODON ANDREWSI, sp. n. (Text-fig. 30.)

This species is founded on a nearly perfect skull from the same horizon and nearly the same spot at Biesjespoort that yielded the type of *D. sollasi*. In addition to the type specimen I have two others which I refer to the same species—one from a locality between Murraysburg and Biesjespoort, and the other from a locality 3 miles east of Biesjespoort. As this latter specimen was found in near association with a specimen of *Cistecephalus* sp., it gives us the horizon as the base of the *Cistecephalus* zone.

The species is a very strikingly new type, which may ultimately have to be placed in a new subgenus.

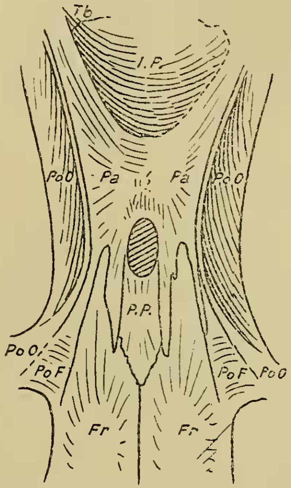
In general shape the species resembles typical Dicynodons. The snout is unusually short, the preorbital region being only about one-fifth the length of the skull. Above and behind each nostril is a well-marked bony boss, with a fairly broad flat sulcus between. Each of the two specimens which has the maxillæ preserved is tuskless.

The orbits are large, with supraorbital thickening on the frontal bones. The frontal region is slightly concave behind, and in front a low median elevation leaves each frontal bone slightly concave.

The parietal region is broad, and unlike the typical species of *Dicynodon*, the parietals are not overlapped by the postorbitals. The large size of the parietals makes a distinct approach to the broad-headed Dicynodonts of the type of *Dicynodon tigriceps* Owen, and for which I am proposing a new genus. In fact, *D. andrewsi* may be the ancestor of *D. tigriceps*.

The preparietal is well developed, and the relations of the bones in this region are very similar to the typical *Dicynodon* arrangement. There is a large postfrontal.

Text-figure 30.



Parietal region of *Dicynodon andrewsi* Broom.

The following are the principal measurements of the type:—

| | | | |
|---|---|---|---|
| Greatest antero-posterior length... | about | 260 | mm. |
| Basal length ........................ | ,, | 210 | ,, |
| Greatest width........................ | ,, | 230 | ,, |
| Interorbital width ............................ | | 43 | ,, |
| Intertemporal width ........................ | | 46 | ,, |

I have much pleasure in naming the species after Dr. C. W. Andrews, F.R.S., of the British Museum.

### DICYNODON OSBORNI, sp. n. (Text-fig. 31.)

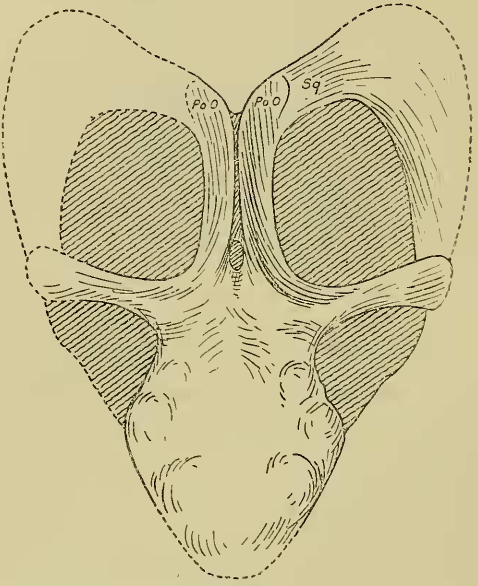
This very strikingly new species is from Wapatsberg, near New Bethesda Road, and is from beds which are undoubtedly in the *Lystrosaurus* zone. In the same horizon are found not only *Lystrosaurus*, but the Therocephalian recently described by me as *Moschorhinus kitchingi*. When *Moschorhinus* was described the exact locality was unknown to me, and when later I discovered it I made a special expedition to the spot to try and discover the back portion of the skull. Though I did not succeed in getting the rest of the type, I got another imperfect skull, two specimens of *Lystrosaurus*, and the type skull which I am now describing.

The present skull is not only of much interest as a new type, but is of great importance as being one of the very few *Dicynodon* skulls known from the *Lystrosaurus* zone, and the only known large one.

The skull lacks the lower jaw, and has lost by weathering the front of the snout, the right jugal arch and part of the left, but otherwise is fairly complete. Unfortunately, the matrix is hard, and though most of the bony surface has been displayed, it is almost impossible to be sure of the sutures.

The whole skull is broad and flat. When perfect it probably measured about 16½ inches in length, and it must have been fairly wide.

Text-figure 31.



Skull of *Dicynodon osborni* Broom. Greatly reduced.

The snout is relatively long, and apparently resembled in some respects that of *Kannemeyeria*, and as in that genus, there are a pair of very powerful tusks. The nasal region has been broad and rounded, without any very striking bony bosses.

The frontal region is wide and moderately flat. Low but well-developed bosses are above the anterior half of each supraorbital margin.

The intertemporal region is relatively narrow, and a marked median crest is formed by the flattened parietal overlapped by the large postorbitals.

The preparietal region has not been satisfactorily revealed. The pineal foramen is evidently small, and situated well back between the approaching postorbitals. Whether a preparietal bone is present or not the evidence does not show. There is certainly no preparietal boss such as occurs in the species of *Eocyclops*.

The orbits look almost directly upwards.

The postorbital arches are long and well developed.

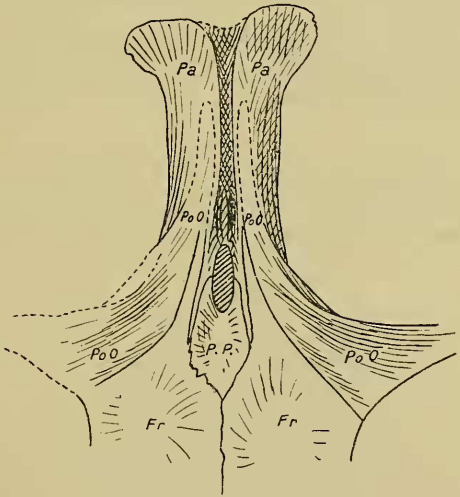
The squamosals must have been extremely broad, judging from the portions preserved.

The following are the principal measurements of the type :—

| | | | |
|---|---|---|---|
| Greatest antero-posterior length... | about | 460 | mm. |
| Greatest width ........................ | ,, | 420 | ,, |
| Distance between tusks ...................... | | 80 | ,, |
| Interorbital width ............................ | | 100 | ,, |
| Intertemporal width ......................... | | 45 | ,, |
| Basal length ........................... | about | 410 | ,, |

I have much pleasure in naming this new type after Prof. H. F. Osborn.

Text-figure 32.



Top of parietal region of skull of *Dicynodon watsoni* Broom.

The degree to which the postorbitals overlap the parietals is unknown, but most probably it is not greater than is indicated in the figure.

### DICYNODON WATSONI, sp. n. (Text-fig. 32.)

This new species is founded on a very fragmentary skull, of which little more than the frontal and parietal regions are preserved, found on the mountain to the east of New Bethesda, about 800 feet above the horizon of the village and probably in the *Lystrosaurus* zone. It is a near ally of *D. osborni* though quite a distinct species, and important in giving details of the structure of the preparietal region.

The frontal region is broad and slightly convex, and the parietal region is in the same plane as the general frontal plane. There are no supraorbital bosses as in *D. osborni*, the whole frontal surface being unusually smooth and slightly convex.

The postorbitals are large and form a considerable part of the upper cranial surface. Posteriorly they clasp the parietals, and with them form the parietal crest. Curiously enough, each postorbital has had its posterior process broken off near the plane of the pineal foramen, probably as the result of the bite of some carnivorous enemy; but there is little doubt that they extended backwards, though not so far as in typical Dicynodons, as the grooves for their lodgement are preserved. Probably, however, they did not quite extend to meet the squamosals.

The preparietal is moderately large and wide, and forms the margin of anterior third of the pineal foramen.

The postfrontal, though fairly large, is almost entirely hidden on the surface by the frontals and the postorbitals.

I have much pleasure in naming the species after Mr. D. M. S. Watson.

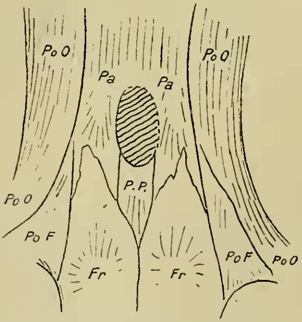
The following are the principal measurements:—

| | |
|---|---|
| Interorbital width ........................ | 58 mm. |
| Intertemporal width ...................... | 20 ,, |

### Dicynodon curtus, sp. n. (Text-fig. 33.)

The type of this new species is a complete but distorted skull found by me at Biesjespoort. The horizon is probably about 100 feet above that in which the type of *D. sollasi* was obtained, but it is quite possible that *D. sollasi* may have survived to be contemporaneous with this other type. In any case, though this type is similar in size to *D. sollasi*, it is very strikingly different in nearly every detail.

Text-figure 33.



Preparietal region of *Dicynodon curtus* Broom. Nat. size.

The skull is short, broad, and deep, and about 4 inches in length.

The snout is bent down and the caniniform processes are under the orbits. There is no great thickening of the nasals. The orbital region is narrow and the parietal region moderately wide.

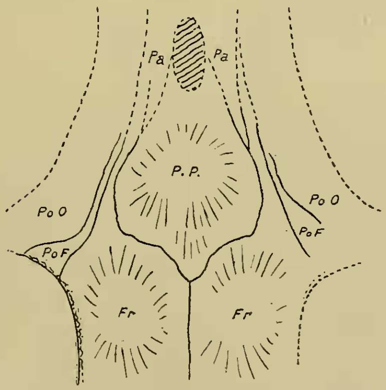
The pineal foramen is large and rounded. The preparietal is small and narrow, and the postfrontals very largely developed. The parietals are fairly well exposed between the postorbitals, but are extremely short. The postorbitals in the temporal region are broad and overhang the temporal fossæ.

The nearest ally to this species, which I propose to call *Dicynodon curtus*, is *Dicynodon dubius* Owen, from which it differs in the unusual shortness of the parietals and in other proportions.

The following are the principal measurements:—

| | | | |
|---|---|---|---|
| Greatest antero-posterior length... | about | 110 | mm. |
| Greatest breadth ...................... | ,, | 110 | ,, |
| Basal length ...................................... | | 100 | ,, |
| Interorbital width ........................... | | 20 | ,, |
| Intertemporal width ......................... | | 27 | ,, |
| Between the caniniform processes | about | 22 | ,, |

Text-figure 34.



Preparietal and its relations in *Dicynodon woodwardi* Broom. Nat. size.

### DICYNODON WOODWARDI, sp. n. (Text-fig. 34.)

The skull which forms the type of this new species was sent to me from near New Bethesda by Mr. C. Kitching, and I am not quite sure of its horizon. Pretty certainly it is from some part of the *Cistecephalus* zone.

Though the whole of the base of the skull is preserved, much of the upper surface is unfortunately lost, including both postorbital arches with the whole of the postorbital bones, practically the whole of the parietal region, and both squamosals. Still, what is preserved shows that it is a strikingly new type, and I have much pleasure in calling it after Dr. Smith Woodward, of the British Museum.

The skull is moderately small, having measured about 6 inches in length. The snout is long and narrow, the preorbital portion of the skull being nearly as long as the postorbital. The nasal region is imperfect, but there were probably no great bony thickenings. The maxillæ have each a round tusk, the head of which lies under the orbit, and the tusks are relatively farther back from the front of the beak than in most species.

The frontals are long and moderately narrow. Behind them lies a most remarkably broad preparietal quite unlike that of any other known species. By its sides are narrow posterior processes of the frontals. The postfrontals lie outside the frontal processes. The postorbitals are lost, but from the condition of the posterior parts of the squamosal it is manifest that the temporal region must have been comparatively narrow.

The following are the principal measurements:—

| | | |
|---|---|---|
| Greatest antero-posterior length... about | 160 | mm. |
| Greatest breadth .......... . perhaps about | 110 | ,, |
| Basal length .................................... | 145 | ,, |
| Interorbital width ........................... | 30 | ,, |
| Distance between tusks ..................... | 29 | ,, |

### Dicynodon ictinops, sp. n. (Text-fig. 35.)

This new species is formed on the nearly perfect skeleton of a small animal found by me about 30 miles from Biesjespoort on the Murraysburg Road. While it is quite possible that the form is not quite fully grown, it cannot be the young of any known species.

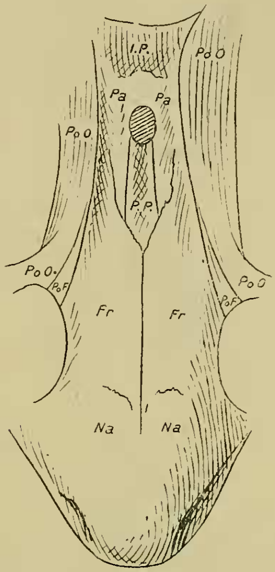
The head is about $3\frac{1}{4}$ inches in length, and the whole animal from snout to the tip of the tail about $12\frac{1}{2}$ inches.

The snout is smooth and rounded, without any bony thickening either on the nasals or in the supraorbital regions, except a very slight thickening on the nasal just where it overhangs the nostril. The septomaxillary does not appear to show on the face. The lacrimal and prefrontals are small. In the maxillæ is a small tusk.

The frontals are large, and a transverse section in the orbital region would show a convex upper surface, while a section of the posterior end would have a concave upper surface. The postfrontals are small, and only a small part appears on the surface. The preparietal is rather small, its anterior end being on the plane of the postorbital arch. The pineal foramen is situated far back. The parietals are small. The postorbitals are very large, and their posterior processes are kept apart farther than in most *Dicynodon* species.

On some future occasion the skeleton will probably be described in detail. For the most part the bones are surrounded by very hard calcareous masses, and are very difficult to clear.

Text-figure 35.



Top of skull of *Dicynodon ictinops* Broom.

The following are the principal skull-measurements:—

| | | | |
|---|---|---|---|
| Greatest antero-posterior length | | 82 | mm. |
| Greatest breadth | | 68 | ,, |
| Interorbital width | | 18 | ,, |
| Intertemporal width | | 19 | ,, |
| Basal length | about | 70 | ,, |
| Distance between canines | | 15 | ,, |

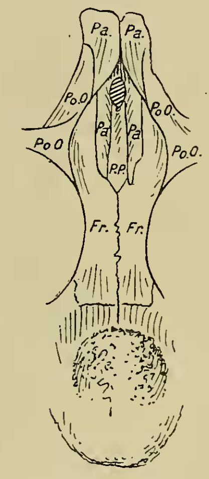
Dicynodon macrorhynchus, sp. n. (Text-fig. 36.)

This new species is founded on two small skulls discovered by me at New Bethesda. For a time I considered they might be very miniature specimens of *Dicynodon platyceps*, the common New Bethesda species, but further careful examination shows that it is necessary to regard them as belonging to a distinct species. The best preserved specimen is taken as the type.

The skull when complete was considerably less than 3 inches in length, and if an adult it represents one of the smallest known species of *Dicynodon*. It is chiefly remarkable for the great length of the orbital and preorbital regions as compared with the postorbital.

In the nasal region there is a large median thickening resembling that in *Dicynodon sollasi*. The frontal region is narrow and the orbits large. The postorbital arch is slender and the postorbital bones are quite unusual in shape. There is no trace to be seen, at least on the upper surface, of any postfrontal, and the postorbital takes its place, having an anterior process which forms a considerable part of the supraorbital margin. The posterior process is unusually short, much of the temporal wall being formed by the parietal. The pineal foramen is of moderate size, and is situated as shown in the figure given. The preparietal is long and narrow.

Text-figure 36.



Top of skull of *Dicynodon macrorhynchus* Broom.

The posterior portion and much of the palate are crushed.

The following are the principal measurements:—

| | | |
|---|---|---|
| Greatest length ......... probably about | 70 | mm. |
| Interorbital width ............................ | 7·5 | ,, |
| Intertemporal width ........................ | 8 | ,, |
| From snout to front of pineal foramen... | 47 | ,, |

*Dicynodon macrorhynchus* is allied to *D. sollasi*, *D. testudiceps*, and *D. ictidops*, but being from the middle of the *Cistecephalus* zone, must be from a horizon many hundreds of feet higher than that of any of these others.

### BAINIA TIGRICEPS (Owen), gen. n.

One of the first species of *Dicynodon* to be described by Owen was *Dicynodon tigriceps*. This is represented in the British Museum by a very fine skull, said to have come from "Gonzia River, Kaffraria." In general appearance it differs very considerably from the typical *Dicynodon* as represented by *D. lacerticeps*. The skull is massive and extremely broad and flat, and the parietal region differs in that the parietals are well developed and not covered by the postorbitals. The genus *Dicynodon* is so large that it would be convenient if we could lop off a few species and put them into a subgenus, even if the differentiating characters did not seem of very fundamental importance. But there is another character that is of great importance. I know of nine skulls which belong either to *Dicynodon tigriceps* or closely-allied species, and all have tusks. It is therefore very highly probable that the female of *Dicynodon tigriceps* was tusked, and not like the female *Dicynodon*—tuskless. And if this be so, *Dicynodon tigriceps* must be placed in a distinct genus. It is, of course, impossible to prove that the female was tusked, and even if 50 tusked skulls were found there would still be a doubt. As it is, I think the probability sufficiently great to make for it a new genus, *Bainia*, after the father of South African geology, Andrus Geddes Bain—one of the most gifted geological geniuses the world has seen. Even if a tuskless female should turn up, *Bainia* must still stand as a subgenus.

### BAINIA PEAVOTI, sp. n. (Text-fig. 37.)

This new species is founded on a very fine skull discovered by me at Biesjespoort. The skull is well preserved and not much crushed. One zygomatic arch is lost, also part of the base and the lower jaw. Though very similar in size to *Bainia tigriceps*, it differs in many important features; and as it is manifestly a new species, I have much pleasure in naming it after the late Henry G. Peavot, who for some years was the Zoological Society's Librarian and Clerk of Publications, and whose care and kindly help all workers so fully appreciated. It is a delight to be able to add a stone to the cairn of a fellow-worker and friend who laid down his life on the battlefield.

The skull is of special value in that all the sutures can be made out with perfect distinctness. In general shape it agrees more closely with *B. tigriceps* than with *B. laticeps*, but differs in the shape of the zygomatic arch and in many other details which will be mentioned. The snout and the whole front half of the skull is much flatter than in any other known Anomodont.

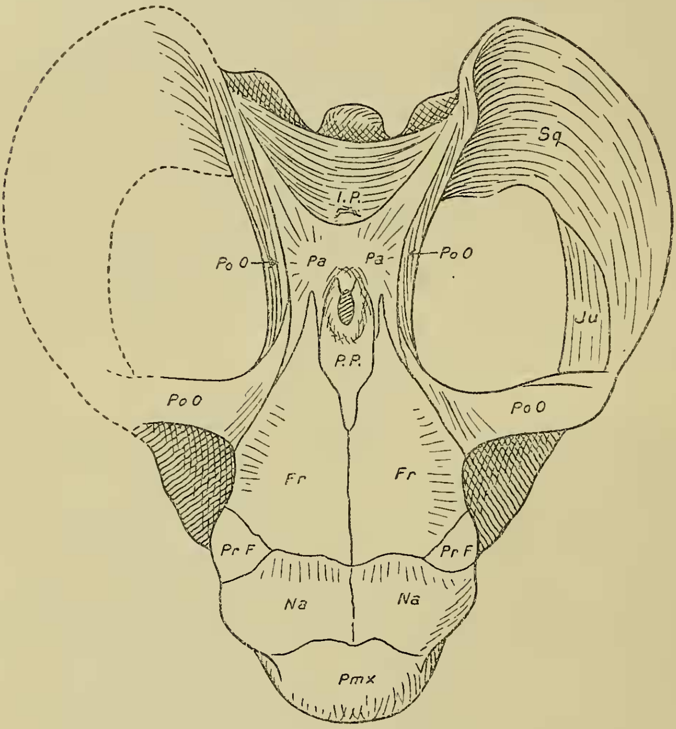
The premaxilla, which is nearly complete, is relatively small and unusually flat.

The nasals are short but very broad, and have each a well-developed boss which overhangs the nostril. The suture with the frontals and prefrontals is nearly transverse.

The septomaxilla is not satisfactorily preserved, but is relatively small.

The maxilla is a very remarkable bone, quite unlike that in any other known Dicynodont. The bone of the left side has lost the subnasal portion, but is otherwise nearly complete, and it is so remarkably shallow that one would fancy the palatal half had been removed; yet if part of the bone has been removed, it must have been done during the animal's lifetime. There is no trace of a tusk, yet there are the remains of the socket of a large tusk. A not improbable explanation of the peculiarity is that the animal is aged and has lost its tusks, and that in consequence the palatal portions of the bone have become absorbed, as is seen in aged human and other mammalian jaws.

Text-figure 37.



Skull of *Bainia peavoti* Broom.

The prefrontal is a relatively small trianguar bone which has a small and not very prominent boss above the front of the orbit.

The lacrimal is small.

The jugal is large. It forms most of the lower border of the orbit, most of the postorbital arch, and a considerable part of the zygomatic arch.

The frontal is unusually large and wide. Its shape will be best understood from the figure given. It has apparently a large articulation with the postorbital, but a thin little strip of the postfrontal is really wedged in between them. The frontal passes back to the plane of the posterior end of the pineal foramen.

The postfrontal scarcely appears on the surface, but though nearly hidden by the frontal and postorbital, it is really a bone of appreciable size underneath.

The postorbital is a large and powerful bone. It forms most of the strong postorbital arch and the whole of the upper border of the temporal fossa, and pretty certainly articulates with the squamosal.

The preparietal is unusually large. It passes far forwards between the frontals, and posteriorly nearly surrounds the pineal foramen.

The parietals appear to be ankylosed into a fairly large bone lying mainly behind the pineal foramen. It forms a moderately large, somewhat concave intertemporal region. Anteriorly it sends forward on each side a slender process between the frontal and postorbital, and posteriorly a long process between the postorbital and interparietal.

The interparietal is a little broader than the middle part of the parietal. Laterally it articulates with the large tabular.

The occiput is fairly well preserved, and was probably much like that of *Bainia tigriceps*, though some degree of crushing of the squamosals gives it a rather different appearance. The occipital condyle is much shorter in the present species.

The squamosals are, as in all Dicynodonts, large and powerful. The shape of the zygomatic portion can be seen in the figure to differ appreciably from that in *B. tigriceps*.

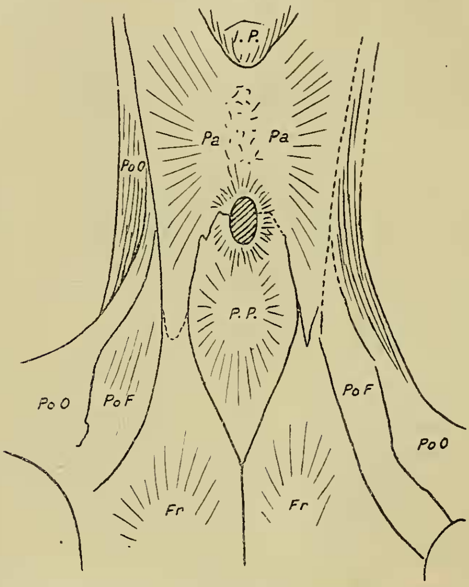
The following are some of the principal measurements :—

| | | |
|---|---|---|
| Greatest length (oblique) …………… | 500 | mm. |
| Greatest breadth …………………… | 480 | ,, |
| Basal length ………………………… | 400 | ,, |
| Width across nasal bosses …………… | 163 | ,, |
| Interorbital width …………………… | 133 | ,, |
| Intertemporal width across parietals… | 50 | ,, |
| Intertemporal width across postorbitals…………………………… | 86 | ,, |

### BAINIA HAUGHTONI, sp. n. (Text-fig. 38.)

In Haughton's paper on the Anomodonts in the South African Museum, recently published, he figures and describes a skull (S. A. M. No. 3328) which he believes to be a young specimen of *Dicynodon laticeps*. I have examined this skull, and while it has all the appearance of a young skull, it cannot, in my opinion, be the skull of a young *D. laticeps*, as it differs in having a very large preparietal and very large postfrontals. Nor can it be the young of either *Bainia tigriceps* or *D. peavoti*. And as it differs from all these three species, but manifestly belongs to this group, it is necessary to make it the type of a distinct species which I have much pleasure in naming after Mr. S. H. Haughton, who is doing excellent work in the vast South African field.

Text-figure 38.



Parietal, preparietal, and frontal regions of *Bainia haughtoni* Broom.

Mr. Haughton, in addition to describing the specimen, has given a figure of the preparietal region. While his figure is essentially correct, a camera lucida drawing I have made of this region gives, I think, a little more accurately the position of the sutures.

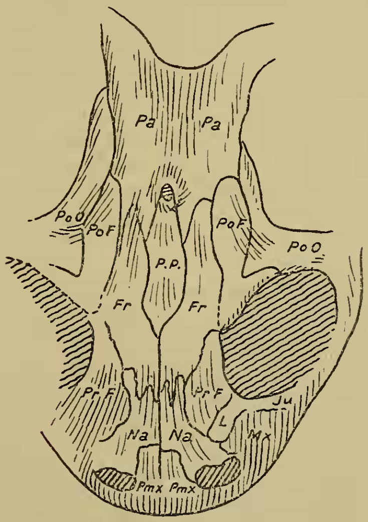
The following are some of the principal measurements :—

| | | |
|---|---|---|
| Interorbital width ........................ | | 46 mm. |
| Intertemporal width ...................... | | 34 ,, |
| Across the nasals............................ | | 52 ,, |
| Between the canines ............ | about | 50 ,, |

EOSIMOPS NEWTONI, gen. et sp. n. (Text-fig. 39.)

This genus and species is founded on a skull which I discovered at Victoria West, and which is of special importance as throwing some light on the age of the rocks which yielded the unique fossil forms *Galechirus scholtzi*, *Heleosuchus scholtzi*, *Arnognathus parvidens*, and *Heleophilus acutus*. When these fossils were discovered by Mr. Scholtz no other fossil had been found within 40 or 50 miles, and there was much doubt as to the age of the deposit. When I described the forms I thought it very likely that they were some of the land representatives of the *Lystrosaurus* zone. Shortly afterwards Mr. A. L. du Toit, of the Geological Survey, reaching Victoria West from the north through a very unfossiliferous region, came to the conclusion that the beds at Victoria West were probably of the *Pareiasaurus* zone. For many years I have taken Mr. du Toit's opinion, but working from the South I have been compelled to differ. Biesjespoort, which lies about 20 miles south of Victoria West, is very rich in fossils, and is certainly at the base of the *Cistecephalus* zone. For miles the strata are almost perfectly horizontal, and it is hard to believe that the beds at Victoria West can be much lower than those at Biesjespoort. Unfortunately, the intermediate beds so far as examined are almost

Text-figure 39.



Skull of *Eosimops newtoni* Broom.

The apparent asymmetry is partly due to crushing, but largely owing to different degrees of the surface of the bones having been flaked off.

devoid of fossils till we come to the little rich patch at Victoria West. Soon this locality will be for ever drowned in a large dam which is being made above the township.

A small Dicynodont skull was some years ago discovered in the deposit, which I referred to *Pristerodon mackayi* Huxley, and took this as confirmatory evidence of the deposit being in the *Pareiasaurus*-zone; but we now know that very similar forms belonging to the genus I am calling *Emydopsis* occur in the *Cistecephalus* zone.

The new Dicynodont skull which I have discovered is nearly perfect, but being in a hard matrix cannot be very satisfactorily developed. It is about 5 inches long and 4 broad, and is chiefly remarkable from having the preorbital region very short and deflected and the parietal region very broad.

The premaxilla is extremely small and short. The nostrils are large and directed forwards. The nasals, like the premaxilla, are also unusually small. The septomaxilla does not show on the facial surface. The maxilla though fairly well developed is very short. It has a rather small slightly flattened tusk.

The prefrontal and lacrimal are both small. The frontals are long and narrow, and form only a small part of the orbital margin. Between them lies an exceptionally large and long preparietal. The postfrontals are also very large. The postorbitals, on the other hand, have very short posterior processes which do not meet the squamosals. The parietals are well developed and broad.

The pineal foramen is unusually small.

The squamosal does not seem to present any unusual features.

The occiput has not been cleaned of matrix.

The species in the folding down of the snout recalls *Lystrosaurus,* though the narrow interorbital region gives the upper surface quite a different appearance. In *Dicynodon moschops* Broom we have a very similar folding down of the snout, and at first sight one might be led to think that this skull was the male of *D. moschops*. When, however, we look at the structure we find very great differences. In *D. moschops* we find the septomaxillary large and forming part of the face. Here it does not appear on the face. Further, in *D. moschops*, though the parietals are also broad the preparietal is small, and there are no postfrontals showing on the upper surface. The species of *Bainia* also show some affinities with the present type, but they all differ in having the frontal region broader than the parietal. Still we may conclude that this Victoria West type has affinities with *D. moschops* on the one hand and with the species of *Bainia* on the other. As all the known species of *Bainia* occur in the *Cistecephalus* zone, as does also *D. moschops*, we may, I think, conclude that the Victoria West animal is either from the *Cistecephalus* zone or from the zone immediately below—viz., the *Endothiodon* zone. In any case it is pretty certain that the Victoria West deposit cannot belong to the *Pareiasaurus* zone.

It is certainly very remarkable that, while we know the faunas of the *Endothiodon* and *Cistecephalus* zones fairly well, nowhere else have we ever come across any of the forms that occur at Victoria West.

Though the present Dicynodont is fairly new to the typical Dicynodons, I think it well to make it the type of a new genus, which may be called *Eosimops*, characterized by the very short deflected snout and the broad and unusual condition of the parietal region. The specific name has been given in honour of Mr. E. T. Newton, F.R.S., whose work I have always greatly admired.

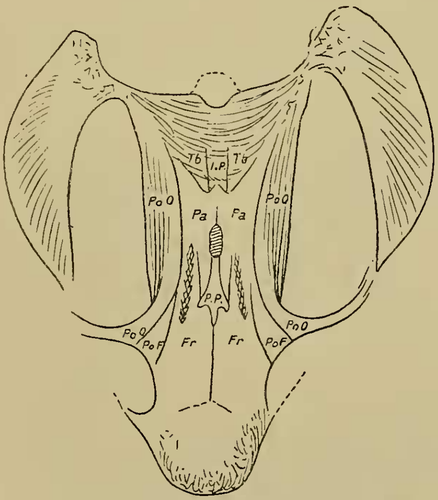
The following are the principal measurements:—

| | | | |
|---|---|---|---|
| Greatest antero-posterior length... | about | 140 | mm. |
| Greatest breadth .................... | ,, | 100 | ,, |
| Interorbital width .......................... | | 30 | ,, |
| Intertemporal width ........................ | | 33 | ,, |

### Palemydops platysoma, gen. et sp. n. (Text-fig. 40.)

This new genus and species is founded on a beautiful skull and part of the skeleton of a small Dicynodont found by me at Biesjespoort. The head is barely 3 inches long, and one might consider the possibility of its being a young *Dicynodon*. But this cannot well be the case, as the bones are well ossified and the tusk apparently fully formed. Further, the structure of the top of the skull is unlike that in any known species of *Dicynodon*.

Text-figure 40.



Skull of *Palemydops platysoma* Broom.

In fact, the top of the skull differs so greatly from that of typical Dicynodons, that I feel justified in making the specimen the type of a new genus, *Palemydops*.

The skull is flat and broad. The snout is very short. There are no indications of any thickenings of the nasal bones. The maxilla is short and has a well-developed round tusk. The sutures of the snout elements cannot with certainty be made out.

The frontals are moderately broad, and on the back part of each is a long deep, probably glandular pit. The postfrontals are large, and form a considerable part of the orbital margin. The postorbitals are very large, and form the whole of the inner wall of the temporal fossa.

The preparietal is relatively small and narrow. The pineal foramen is small, and lies much behind the plane of the postorbital arches. The parietals are large.

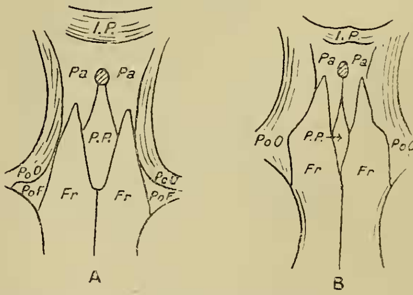
The following are the principal measurements of the skull:—

| | |
|---|---|
| Greatest antero-posterior length ...... | 75 mm. |
| Greatest width.............................. | 67 ,, |
| Interorbital width ......................... | 16 ,, |
| Intertemporal width ..................... | 20 ,, |

Emydopsis trigoniceps (Broom), gen. n. (Text-fig. 41 A.)

In 1904 I described a small Anomodont skull as a species of *Oudenodon* and called it *Oudenodon trigoniceps*. With the much greater knowledge which we now have it became pretty manifest that it could not be a species of *Oudenodon*, or rather of *Dicynodon*, the parietal region being quite different from the *Dicynodon* type. The specimen is now in the Albany Museum, and Mr. J. Hewitt, the Curator, kindly sent it to me on loan for further examination. I discovered on breaking into the maxilla that there are three or four slender molar teeth. These are long

Text-figure 41.



**A.** Preparietal region of *Emydopsis trigoniceps* Broom.
**B.** Preparietal region of *Emydopsis sciuroides* Broom.

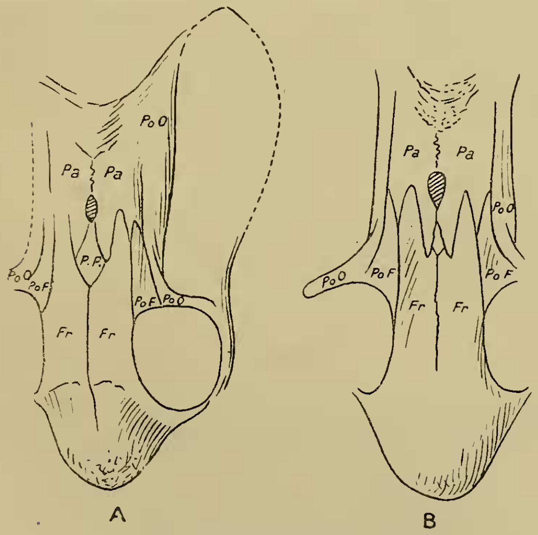
and rounded, and with small serrations on the posterior side of the upper portions of the crowns. Manifestly the genus is allied to *Pristerodon* and to *Emydops*, and also to *Diælurodon*, but it seems wisest to make a new genus for those forms with three or four slender posteriorly serrated teeth. *Pristerodon* has a larger number of molars—6, 7, or 8—and they are robust teeth. *Emydops* has a few teeth which are apparently not serrated. *Diælurodon* has a number of molars which have serrations both in front and behind.

*Emydopsis trigoniceps* (Broom) may be taken as the type species of the new genus.

### Emydopsis longus, sp. n. (Text-fig. 42.)

This species is founded on a collection of eight good and a number of imperfect skulls found by me at Biesjespoort. They occur in exactly the same horizon as *Dicynodon sollasi*. As most of the skulls are about $2\frac{1}{2}$ inches in length, and no one is more than $2\frac{3}{4}$ inches, we may safely conclude that they are adult skulls.

Text-figure 42.



Skulls of *Emydopsis longus* Broom.

**A.** Type skull.

**B.** Skull of a topotype illustrating the variability of the preparietal.

The snout is very appreciably shorter than the antero-posterior diameter of the orbit. It is above rounded and moderately smooth, though the nasal bones are uniformly thickened. The septomaxillary does not seem to be seen on the face, though it is impossible to be quite certain.

The frontals are long and narrow, and nearly shut out from the orbital margins by the præfrontals and large postfrontals. They pass far backwards by the sides of the preparietal. The frontals are moderately flat.

The preparietal differs in different specimens considerably, but the appearance of the postfrontals, postorbitals, and parietals is very constant. I give figures of the region in two specimens to illustrate the variation.

The parietals are large and broad and flanked by the postorbitals.

In no specimen is there a tusk, but in both upper and lower jaws are a few slender posteriorly serrated molars. The number appears to vary with age. In a beautifully preserved lower jaw there are three teeth. The first is large and is on the point of being shed, the replacing tooth being seen below it. The second tooth is also well developed. The third tooth is very small.

A few years ago Haughton and I described a small skull from Dunedin, which we provisionally referred to *Emydops* and named *Emydops platyceps.* There can be little doubt that this is very closely allied to the present species, and should be transferred to the genus *Emydopsis.*

The only striking difference between *Emydopsis platyceps* and *Emydopsis longus* is that in the latter the posterior part of the skull is much longer and broader, and while *E. platyceps* has slender tusks, *E. longus* has none.

The following are the principal skull measurements (in millimetres) of three specimens :—

| | Type. | B. | C. |
|---|---|---|---|
| Greatest length ............ | 64 | 68 | 72 |
| Greatest width ...... about | 48 | about 54 | about 52 |
| Interorbital width ......... | 12 | 11 | 12 |
| Intertemporal width ...... | 18 | 18 | 20 |
| Basal length ............... | 59 | about 62 | — |

### EMYDOPSIS SCIUROIDES, sp. n. (Text-fig. 41 B.)

The beautiful little skull which forms the type of this new species was found by me at New Bethesda, the famous locality which has already yielded so many interesting types. Without seriously injuring the skull, it will not be possible to say with certainty if the specimen belongs to *Emydopsis,* but the general resemblance of the skull and lower jaw to those of species of *Emydopsis* is so close as to render it highly probable that the specimen belongs to a species of this genus.

The next striking characteristics of the skull are the large size of the orbit and the relative shortness of the parietal region.

The snout is short but relatively broad. A tiny corner of the septomaxillary appears on the face. The maxilla is deep, and in this type skull at least, tuskless. The prefrontal and lacrimal are small.

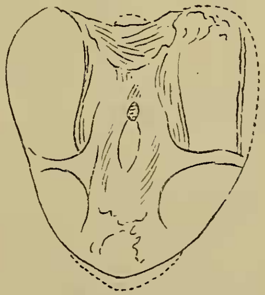
The frontal is very long and narrow, and remarkable in that the postorbital portion is wider than the orbital. The preparietal is almost unique among Anomodonts in being very small and situated entirely in front of the pineal foramen. A similar condition is only known to occur in *Emydopsis arctatus* (Owen). The postfrontal is either entirely absent or does not appear on the surface. The postorbital is very large, and extending forward into the region usually occupied by the postfrontal, forms a considerable part of the orbital margin. The parietal is moderately wide but short, the part behind the pineal foramen being extremely short. The pineal foramen is very small.

In the lower jaw the dentary resembles that of *Emydopsis longus*, but the post-dentary portion of the jaw is relatively much shorter.

The following are the principal measurements of the skull :—

| | | | |
|---|---|---|---|
| Greatest length | about | 60 | mm. |
| Greatest width | doubtfully about | 50 | ,, |
| Interorbital width | | 10 | ,, |
| Intertemporal width | | 17 | ,, |
| Between caniniform processes | | 11 | ,, |
| Basal length | about | 48 | ,, |

Text-figure 43.



Skull of *Emydops parvus* Broom.

The skull is slightly crushed, but could not well have been longer than indicated by the dotted line.

EMYDOPS PARVUS, sp. n. (Text-fig. 43.)

Until the discovery of the present specimen, *Emydops minor* was the smallest known Anomodont, but this new find gives us a type which has certainly a shorter skull and possibly smaller in other respects. This new species is founded on a skull discovered by me at Bruintjeshoogte in the same stratum as yielded the type skull of *Ictidosuchus longiceps* Broom.

The skull is 1½ inches long and rather less in breadth, and the whole animal was probably as small as a newly-born kitten.

The snout is very short, but the structure cannot be made out owing to crushing.

The orbits are small.

The frontal region is relatively narrow, and the temporal region in front nearly twice as wide. Owing to a finely crackled condition of the bones, sutures are very difficult to make out, but the limits of the preparietal can be clearly seen. The pineal foramen is small and situated well back. The general shape of the skull will be best indicated by the drawing given.

There is evidence of at least one small unserrated molar.

The following are the principal measurements of the skull:—

| | | |
|---|---|---|
| Greatest length | about | 38 mm. |
| Greatest breadth | | 35 ,, |
| Interorbital width | | 8·5 ,, |
| Intertemporal width | | 22·5 ,, |

### EMYDURANUS PLATYOPS, gen. et sp. n. (Text-fig. 44.)

The new genus and species is founded on a small skull discovered by me near Biesjespoort, and is one of the most interesting Anomodonts known. The specimen was found in the deposit which has yielded the very numerous skulls of *Dicynodon sollasi*, and before being developed it was looked upon as another of the many duplicates. This was unfortunate, for a beautiful shoulder-girdle lying against the skull was developed out and a portion of the skull sacrificed before it was noticed that the skull is really a very remarkable new type. We have still preserved the greater part of the skull, minus the arches, but with the contact between the occiput and the parietal region lost.

The skull is that of a small Anomodont with a broad, flat head and a wide palate which has on each side three or four teeth.

The premaxilla is broad and shallow. As in typical Anomodonts, it forms the greater part of the bony palate. There is a well-marked median ridge. Its relation to the palatines and maxillæ will be best understood by the figure.

The maxilla is well developed, but is remarkable from the fact that there is very little of a caniniform process. Some distance inside of the alveolar margin are three or four teeth in a row. On the right side the matrix has been left supporting the crowns. The first is a small sharp-pointed unserrated tooth; the second a much broader flattened tooth, also without serrations; the third probably similar to the second; and the fourth a smaller tooth imperfectly preserved. On the left side the matrix, and with it much of the teeth, has been removed. The first tooth is seen to have its root near the suture between the premaxilla and maxilla, and though it doubtless is fixed in the maxilla, it passes through the premaxilla. The others are in the posterior part of the maxilla.

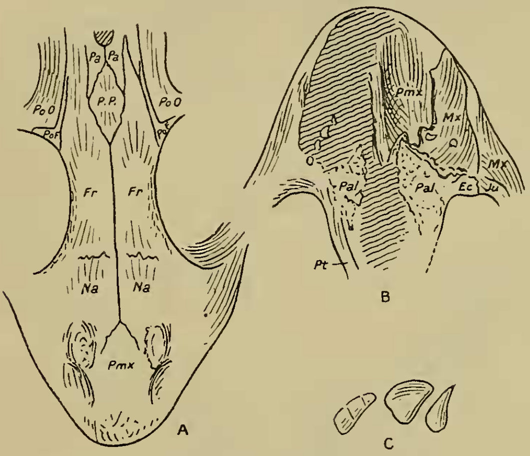
The palatine is well developed and has an unusually large palatal portion, which is rugose and has probably had a horny protection. The posterior part of the palate is not preserved.

The nostrils are situated well forward and separated by the median process of the premaxilla. which passes well back.

The nasals are large. Each has a well-marked boss behind and above the nostril. The septomaxillæ cannot be made out.

The frontal is long and narrow, and passes unusually far behind the plane of the postorbital arch. The postfrontal is small and narrow, but forms a considerable part of the orbital margin.

Text-figure 44.



**A.** Top of skull of *Emyduranus platyops* Broom.
**B.** Palate of *Emyduranus platyops* Broom.
**C.** First three molar teeth of same, enlarged.

The preparietal is remarkable in being situated quite in front of the pineal foramen. It is lozenge-shaped, the two posterior sides articulating with the parietals and the anterior with the frontals.

The postorbitals are large.

The occiput, so far as can be seen, presents no unusual feature.

The following are the principal measurements :—

| | | |
|---|---|---|
| Greatest length…………………… about | 90 | mm. |
| Greatest width ………………………… | 72 | ,, |
| Interorbital width …………………… | 16 | ,, |
| Intertemporal width ………………… | 20 | ,, |
| Between the caniniform processes …… | 25 | ,, |
| Front of snout to front of pineal foramen | 62 | ,, |

This little Anomodont, to which I have given the name *Emyduranus platyops*, shows some affinities with *Cryptocynodon simus* Seeley, and also with *Prodicynodon pearstonensis* Broom, but must be regarded as the representative of a very distinct genus.

### ENDOTHIODON CRASSUS, sp. n. (Text-fig. 45.)

This new species is founded on a beautiful skull discovered by me at Dunedin, Beaufort West district. The skull has lost the lower jaw, and has the parietal region badly weathered and the squamosal portion of the left temporal arch imperfect, but otherwise it is almost complete. With the exception of *Endothiodon whaitsi* it is the largest *Endothiodon* skull known, and it is little inferior to that other, though very different in shape.

Unlike *Endothiodon uniseries* Owen and *Endothiodon whaitsi* Broom, it is very broad and flat, and the parietal region is only slightly elevated above the frontal plane. In general shape and proportions the species which it most resembles is *Endothiodon paucidens* Broom, but that it is very different from this species will be at once evident on comparing the figures.

The premaxilla when viewed from the front is like a thick inverted V, the deep notch being for the point of the mandible, and the two points are the caniniform processes, which here are formed by the premaxilla and not, as in the tuskless Dicynodonts, by the maxillæ. A small knob is situated in front of each nostril. The superior median process passes between the nasals, but is short.

The nasals are very broad, and the bones, like all the bones of the top of the skull, very thick. They are as broad as long, and the whole preorbital portion of the skull is thus much broader than long—a condition which differentiates this species of *Endothiodon* from all others.

The prefrontals are of moderate size, and so thickened that they may be looked upon as forming preorbital bosses.

As in all typical Endothiodons, there are two longitudinal grooves passing from the front of the frontals down the middle of the nasals to the upper corners of the nostrils.

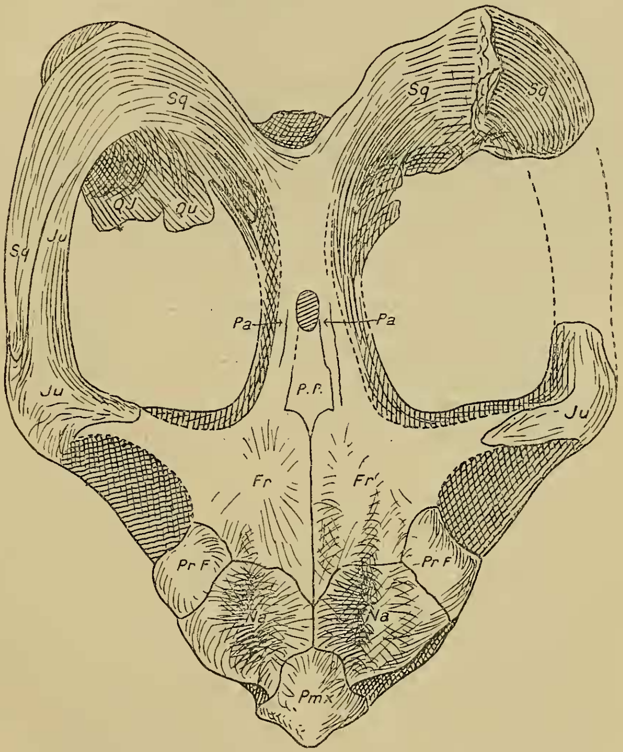
The septomaxilla seems to be small and within the nostril, but the evidence is not satisfactory as to whether it also appears on the face.

The lacrimal is smaller than the prefrontal, but its limits cannot be clearly made out.

The maxilla is a large bone. As in all species of *Endothiodon*, it has a long ridge which forms an alveolar border and at a considerable distance further in a row of teeth. Most of the teeth appear to be lost, but when complete there was probably a single row of eight teeth which measured 74 mm. The first tooth of the series is round in section and has a diameter of 7 mm.; the last, also round, has a diameter of 8·5 mm. The maxilla forms most of the lateral part of the face, and it sends a long and powerful process outwards and slightly backwards below the jugal to strengthen the jugal arch.

The jugal is, as in other Endothiodonts, more powerful than in the Dicynodonts, and has a large rounded descending knob. It sends a long process backwards inside the squamosal.

Text-figure 45.



Skull of *Endothiodon crassus* Broom. Greatly reduced.

The quadrato-jugal and quadrate (*QJ* and *Qu*) of the right side are displaced: those of the left side lost.

The frontals are large, but the exact limits of the bones cannot be made out except in front as most of the orbital margins have been lost.

The preparietal is large and forms the front of the pineal foramen wall.

The parietals are narrow but deep.

The squamosals are powerful. The zygomatic portion is more slender than in Dicynodonts, but the occipital portion is greatly developed.

The quadrate and quadrato-jugal are lost from the left side, but preserved in a slightly displaced condition on the right. As in *Dicynodon*, they are apparently ankylosed, and their displacement from the squamosal and paroccipital adds further evidence to observations I have made in *Dicynodon*, that while the quadrate is fixed to the quadrato-jugal, the quadrato-jugal has a very considerable degree of movement on the squamosal, and thus relatively to the skull the quadrate is perhaps as freely movable as in the Lizard, in Anomodonts, and also in Cynodonts.

The palate is similar to that in other Endothiodonts, and does not differ greatly from the *Dicynodon* type. The periotic processes do not descend to the same degree as in *Dicynodon*, but are clasped by the basisphenoids in a similar manner, and have each a large foramen ovale for the end of the stapes. *Endothiodon* differs from *Dicynodon* in having a large median basisphenoid boss.

The occipital condyle is flat as in other *Endothiodon* species.

The following are the principal measurements of the skull :—

| | | |
|---|---|---|
| Greatest antero-posterior length ...... | 502 | mm. |
| Greatest breadth across squamosals.... | 400 | ,, |
| Greatest breadth across jugals........ | 430 | ,, |
| Breadth across nasals .............. | 180 | ,, |
| Breadth between nostrils............ | 60 | ,, |
| Basal length ...................... | 435 | ,, |